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WASTEWATER SURVEY, ST. REGIS PAPER COMPANY, CANTONMENT, FLORIDA

J. S. Hall

Environmental Protection Agency
Athens, Georgia

August 1972

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REPORT TO THE CONFEREES OF THE SECOND SESSION
(PROGRESS MEETING) OF THE CONFERENCE IN THE MATTER
OF POLLUTION OF THE INTERSTATE WATERS OF
PERDIDO BAY AND ITS TRIBUTARIES
FLORIDA AND ALABAMA

WASTEWATER SURVEY
ST. REGIS PAPER COMPANY
CANTONMENT, FLORIDA

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Springfield VA 22151

August 1972
Environmental Protection Agency
Surveillance and Analysis Division
Athens, Georgia

53

The planning and operation of this project was carried out under the supervision of B. H. Adams, Chief, Engineering Services Branch.

Mr. J. S. Hall was project engineer and principal author of the report.

All Environmental Protection Agency personnel are assigned to the Surveillance and Analysis Division located at Athens, Georgia. The Division is under the direction of J. A. Little.

TABLE OF CONTENTS

TITLE	PAGE NO.
INTRODUCTION	1
FINDINGS	2
PREVIOUS FEDERAL INVESTIGATIONS AND ENFORCEMENT ACTION	5
PLANT DESCRIPTION AND WASTEWATER TREATMENT FACILITIES	8
WATER QUALITY STANDARDS OF RECEIVING WATERS	11
DISCUSSION OF STUDY RESULTS	13
STUDY METHODS	13
GENERAL DISCUSSION	15
ANALYTICAL SAMPLING RESULTS	17
Temperature	17
pH	18
Biochemical Oxygen Demand	18
Total Organic Carbon	19
Chemical Oxygen Demand	22
BOD-TOC-COD Relationships	22
Lignin-like Compounds	24
Color	24
Nitrogen and Phosphorus	25
Residue-Settleable, Total Nonfilterable and Volatile Nonfilterable	27
Organic Scan	29
Bacteriology	29
SHORT CIRCUITING STUDY	31
REFERENCES	34
APPENDICIES	
APPENDIX A, PROJECT PERSONNEL	
APPENDIX B, SAMPLING PROCEDURES AND ANALYTICAL METHODS	
APPENDIX C, WASTE SAMPLING DATA	

LIST OF TABLES

NUMBER		PAGE NO.
I	Alabama and Florida Water Quality Criteria Perdido Basin Use Classifications.	12
II	Station Locations and Analyses Required.	14
III	Data Summary	16
IV	Treatment Pond Efficiencies.	20
V	BOD-TOC-COD Relationships.	23
VI	Organic Compounds.	30

LIST OF FIGURES

NUMBER		PAGE NO.
1	Wastewater Sampling Locations.	9
2	Average 5-Day Biochemical Oxygen Demand Loads.	21
3	Average Color.	26
4	Average Suspended Solids Load.	28

INTRODUCTION

This report contains an evaluation of waste treatment at St. Regis Paper Company's integrated pulp and paper mill located at Cantonment, Florida. Reported results are from a ten-day study which was requested by the conferees at the Perdido Bay Federal-State Enforcement Conference Progress Meeting held in Gulf Breeze, Florida, during January 1972. The field study was conducted by the Environmental Protection Agency during June 1972.

The study was designed to determine waste removal effectiveness of treatment facilities serving the paper mill and to characterize the wastes discharged into Elevenmile Creek.

This is the third Federal report containing data relative to wastewater discharges from the St. Regis Mill (Pensacola Mill) at Cantonment. Previous reports have identified the Pensacola Mill as a major point source of carbonaceous wastes discharged into Perdido Bay and have recommended treatment reductions and effluent limits which have been adopted through Federal-State Enforcement Conference Proceedings. This report presents the results of the June 1972 survey with regard to conference recommendations and compares study results with previous Federal findings.

The cooperation and contribution of the St. Regis Paper Company's mill management during the study are gratefully appreciated. Special acknowledgments are due the personnel of the mill's Technical Department for sampling assistance and to the Pensacola District Office of the Florida State Board of Health for providing laboratory space.

FINDINGS

1. During June 1972, personnel from the Environmental Protection Agency, Region IV, Surveillance and Analysis Division, conducted a 10-day survey of the wastewater treatment system at the St. Regis Paper Company in Cantonment, Florida. Daily pulp production during the survey averaged 830 tons, of which approximately 287 tons per day were bleached; annual pulp production is reported to average 900 tons per day.

2. Treatment facilities consisted of a primary settling basin, nutrient feed system (anhydrous ammonia and phosphoric acid), three aeration ponds (Nos. 1 and 2 in parallel), and a final settling pond. Riffle terraces are located before and after the final pond. Approximately 29 million gallons per day (MGD) of liquid wastes were discharged into Elevenmile Creek. Mill hydraulic conditions were constant; waste flows fluctuated very little, and only trace precipitation was measured.

3. The Pensacola Mill is complying with enforcement conference BOD_5 requirements of not more than 51,000 lbs/day before treatment, 90 percent reduction, and not more than 5,100 lbs/day in the final discharge. Waste concentrations and loads before and after treatment and percent reductions were:

Parameter	Untreated		Treated		Percent[1/] Reduction
	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)	
Biochemical Oxygen Demand (BOD_5)	210	45,000	17	4,050	91
Total Organic Carbon (TOC)	264	57,500	122	29,300	49
Chemical Oxygen Demand (COD)	814	175,000	352	83,400	52
Residue, Nonfilterable	228	49,200	24	5,720	88
Residue, Nonfilterable Volatile	139	30,000	12	2,860	90
Lignin-like Compounds	91	19,600	73	17,300	12
Color (Pt.-Co. Units)	1,290	--	1,100	--	15

4. The mill is complying with the conference recommendation requiring the removal of all settleable solids. Settleable solids were not detectable in the discharge and barely detectable at the primary settling basin effluent.

5. Treatment reduces the total and fecal coliform densities by 37 and 71 percent, respectively. Treated effluent discharged into Elevenmile Creek had a total and fecal coliform density of 12,000 and 230/100 ml, respectively.

6. All of the nitrogen and phosphorus added by the nutrient feed system was not assimilated. Effluent concentrations of nitrogen and phosphorus exceed values normally found in Kraft mills and could accelerate water quality degradation in the upper portion of

---

1/ Percent reductions are calculated on loads.

Perdido Bay.

7. Extreme short circuiting occurred in the primary settling basin. Dye peaked in 5 hours while the calculated theoretical retention time, based on volume, was 30 hours. Short circuiting may have occurred in the aeration ponds -- measured time was 33 hours versus a theoretical time of 60 hours.

8. The wastewater treatment system is located within Elevenmile Creek's flood plain and is subject to hydraulic overload during heavy rainfall.

9. To show the effectiveness of pollution abatement at the Pensacola Mill, the following percent reductions and loads discharged into Elevenmile Creek during previous surveys are shown for comparison with the 1972 study results:

	1969		1970		1971	
Parameter	% Reduct.	Discharge (lbs/day)	% Reduct.	Discharge (lbs/day)	% Reduct.	Discharge (lbs/day)
BOD_5	37	55,300	42	42,500	13	24,000
TOC	--	16,150	29	48,800	21	37,600
COD	--	--	--	--	4	123,000
Susp. Solids	--	--	71	17,100	<1	66,300
Color (Pt.-Co. Units)	--	1,400	--	--	12	770

PREVIOUS FEDERAL INVESTIGATIONS AND ENFORCEMENT ACTION

The first Federal Water Pollution Control Administration[1/] water quality study of Perdido Bay was conducted in September 1969, at the request of the Director, Technical Staff, Alabama Water Improvement Commission. Study results showed that wastes from the St. Regis Paper Company at Cantonment, Florida, adversely affected Perdido Bay, Perdido River, and Elevenmile Creek, and that water quality problems at the mouth of Bayou Marcus were caused collectively by discharges from small sewage treatment plants.(1) A water quality management and waste abatement program to include St. Regis and the sewage treatment plants was recommended. All waste abatement facilities were to be operational by January 1, 1973.

In January 1970, the report was presented at the Federal-State Enforcement Conference, Pollution of Perdido River and Bay, Florida and Alabama. The following recommendations were adopted by the conferees:

- There shall be an overall removal efficiency of 90 percent for carbonaceous waste material from the St. Regis Paper Company. The St. Regis waste effluent, as measured below the present riffle terraces, shall not exceed 8,880 lbs per day of five-day BOD, and 2,610 lbs per day of total organic carbon. All settleable solids shall be removed.
- The St. Regis Paper Company shall remove the foam-causing constituents from its effluent.

1/ Now the Environmental Protection Agency.

- The St. Regis Paper Company shall reduce the color of its waste discharge to meet the water quality standards of Florida, Alabama, and the Federal Government.
- St. Regis Paper Company shall make a feasibility study of an essentially closed system involving recirculation, treatment and reuse of its process water. A progress report shall be submitted to the Conferees by January 1, 1971.

A second wastewater survey of the Pensacola Mill, conducted in November 1970, established representative values of average mill discharges, and evaluated the strength of certain process wastes generated within the mill. This report (2) concluded that the mill was generating an excessive amount of wastes as compared to average Southern Kraft operations and recommended that:

- Generated waste not exceed 51,000 lbs per day; overall removal efficiency be 90 percent for carbonaceous waste material, and
- The daily allowable waste load discharged into Elevenmile Creek be reduced from 8,800 lbs per day to 5,100 lbs per day of BOD_5.

The second session of the enforcement conference was held during February 25-26, 1971. The conferees concluded that water quality degradation in Perdido Bay had continued since the first session and that progress toward reducing waste discharges had not been satisfactory.

The conferees then recommended the BOD_5 revisions proposed in the Federal report.

A limited study to determine if the mill was providing treatment in accordance with the recommendations was conducted in June 1971. Results showed that generated wastes were below the recommended limit; however, treatment was inadequate -- BOD_5 removal was 13 percent.

A progress evaluation meeting was held during January 26-27, 1972. The conferees reviewed progress being made toward consolidation of sewage treatment facilities discharging into Bayou Marcus and recognized improved treatment at the Pensacola Mill. However, the following recommendations were proposed:

- The company shall reduce carbonaceous organic materials and color to the maximum degree feasible with special emphasis on the reduction of these materials in the bleachery wastes.
- EPA and the State of Florida shall make an in-plant investigation of treatment processes and other pollution control measures employed by St. Regis to determine waste reductions at the Pensacola Mill and the effects of the discharges on receiving waters. Special attention will be directed to the extent of the reduction of foam-causing constituents resulting from in-plant process changes and the installation of a secondary treatment system.

PLANT DESCRIPTION AND WASTEWATER TREATMENT FACILITIES

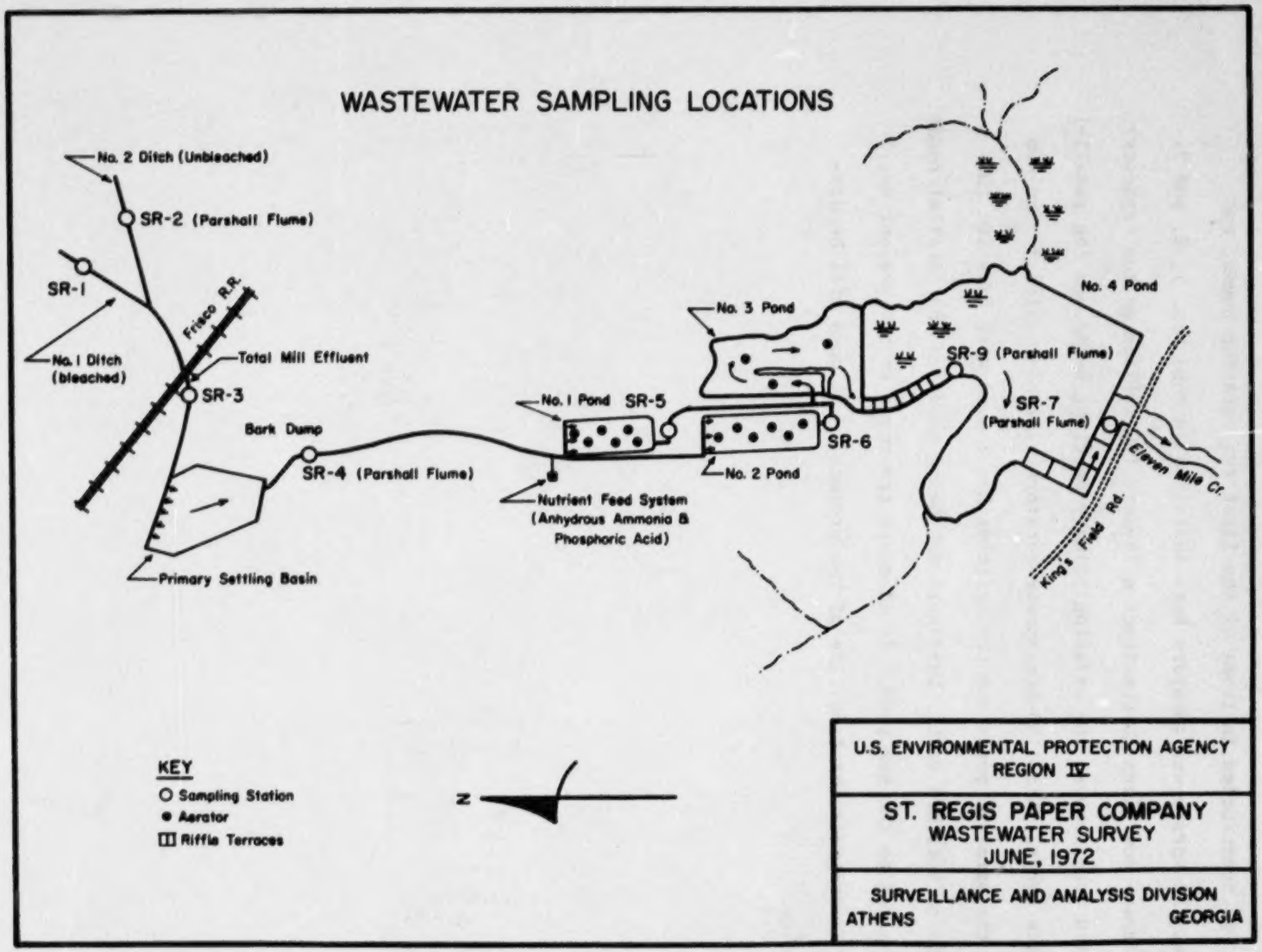
The St. Regis Paper Company operates an integrated pulp and paper mill in Cantonment, Escambia County, Florida. The mill, referred to as the Pensacola Mill, is located approximately 12 miles north of Pensacola. The original mill started operation in 1941; however, it has been expanded to essentially two mills at one site.

Average annual production is approximately 900 tons per 24 hours of bleached and unbleached pulp by the sulfate (Kraft) process. Approximately 250 tons per day of pulp are bleached. Pulp is converted into approximately 850 tons per day of bleached and unbleached paper. Approximately 29 MGD of liquid wastes generated at the plant are discharged into Perdido Bay via Elevenmile Creek.

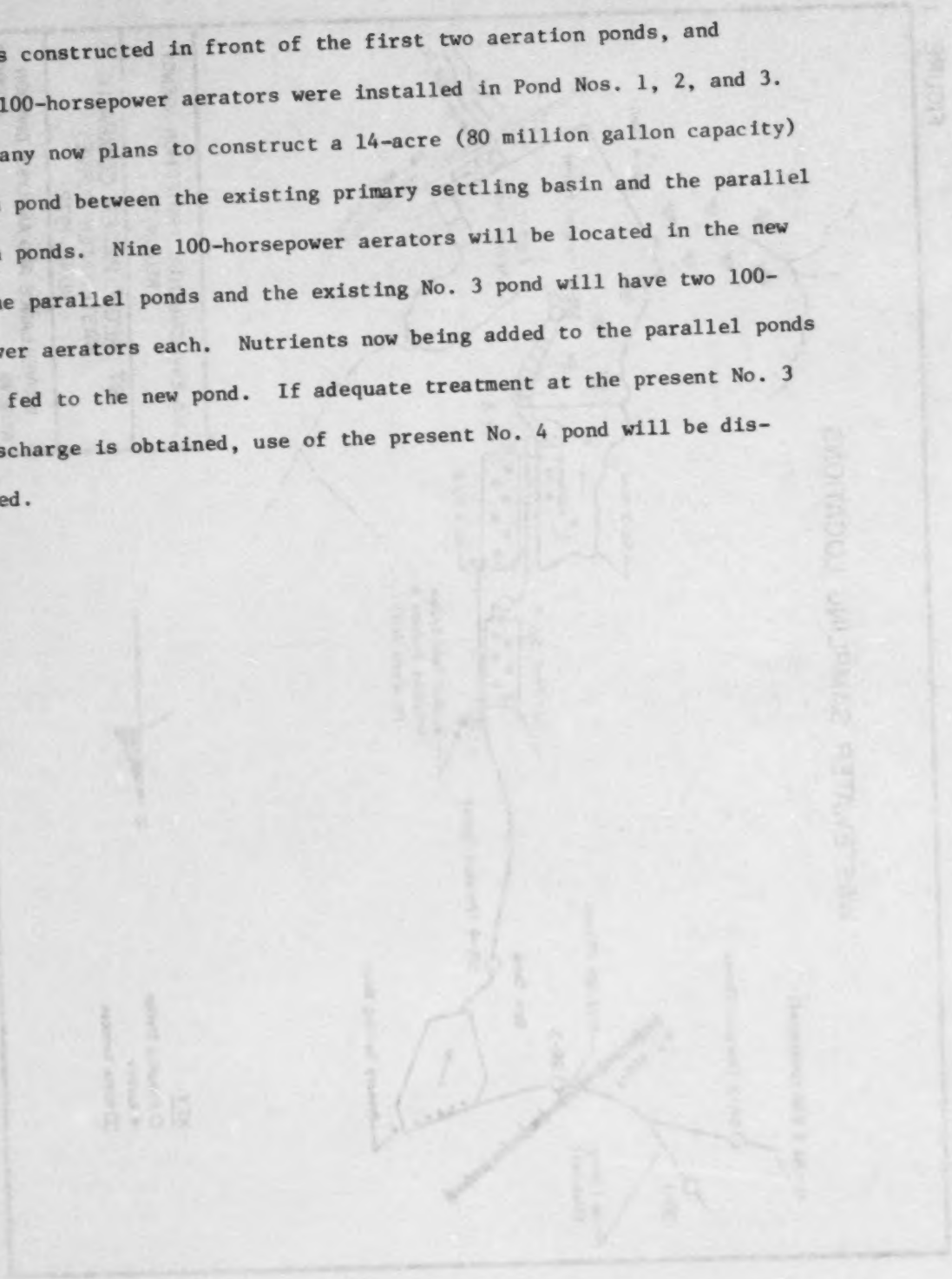
Mill treatment facilities consist of a primary settling basin, a nutrient feed system (anhydrous ammonia and phosphoric acid), three aeration ponds (Nos. 1 and 2 in parallel), and a final settling pond (Figure 1). Riffle terraces are located before and after the final pond. During dry weather, the paper mill discharge into Elevenmile Creek makes up most of the flow. Sanitary wastes are treated in several septic tanks with drain fields.

The mill's first treatment system was a settling basin constructed in 1942; it was abandoned in the mid-1940's. In 1958, two retention basins (now Pond Nos. 1 and 2) were added to the system. In 1959, a retention lake (now Pond No. 3) was constructed downstream of the two basins. In 1965, a second lake (now Pond No. 4) was added to the system. In October 1971, the present system became operable. A primary settling

FIGURE 1


WASTEWATER SAMPLING LOCATIONS
No. 2 Ditch (Unbleached)
SR-2 (Parshall Flume)
SR-1
No. 1 Ditch (bleached)
Frisco R.R.
Total Mill Effluent
SR-3
Bark Dump
SR-4 (Parshall Flume)
Primary Settling Basin
No. 1 Pond
SR-5
Nutrient Feed System (Anhydrous Ammonia & Phosphoric Acid)
No. 3 Pond
No. 2 Pond
SR-6
No. 4 Pond
SR-9 (Parshall Flume)
SR-7 (Parshall Flume)
Eleven Mile Cr.
King's Field Rd.
KEY
Sampling Station
Aerator
Riffle Terraces
N
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ST. REGIS PAPER COMPANY
WASTEWATER SURVEY
JUNE, 1972
SURVEILLANCE AND ANALYSIS DIVISION
ATHENS GEORGIA

basin was constructed in front of the first two aeration ponds, and fifteen 100-horsepower aerators were installed in Pond Nos. 1, 2, and 3. The company now plans to construct a 14-acre (80 million gallon capacity) aeration pond between the existing primary settling basin and the parallel aeration ponds. Nine 100-horsepower aerators will be located in the new pond; the parallel ponds and the existing No. 3 pond will have two 100-horsepower aerators each. Nutrients now being added to the parallel ponds will be fed to the new pond. If adequate treatment at the present No. 3 pond discharge is obtained, use of the present No. 4 pond will be discontinued.



WATER QUALITY STANDARDS OF RECEIVING WATERS

The waters affected by the discharge from the Pensacola Mill are Elevenmile Creek, Perdido Bay, and Perdido River -- all classified as interstate streams. Perdido Bay and River are interstate boundary waters between Alabama and Florida. Elevenmile Creek is a tidal tributary to Perdido Bay.

The Alabama Water Improvement Commission classified Perdido Bay for swimming, shellfish harvesting, and fish and wildlife uses. The Perdido River was classified for fish and wildlife uses only. The Florida Department of Pollution Control classified Perdido Bay and Perdido River as Class III waters -- waters suitable for recreation and the propagation and management of fish and wildlife. Elevenmile Creek is classified by Florida as Class V waters -- navigation, utility and industrial use.

Specific criteria originally adopted by Alabama and Florida are being revised and have not been finalized. Table I shows a summary of water quality criteria presently adopted by the states.

Table I

Alabama and Florida Water Quality Criteria
Perdido Basin Use Classifications

	Alabama			Florida	
Criteria Item*	Swimming	Shellfish Harvesting	Fish & Wildlife	Class III	Class V
Temperature	Max. 93°F (Not more than 10% increase above ambient)			Insufficient to damage aquatic life, vegetation, or interfere with classified use	Not specified
Dissolved Oxygen	≥ 4.0 mg/l	≥ 4.0 mg/l	≥ 4.0 mg/l	≥ 4.0 mg/l	Not less than 1.0 mg/l (ave. value ≥ 2.0 mg/l)
pH	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.0 to 8.5	5.0 to 9.5 (swamp waters to 4.5)
Bacterial	Monthly ave. 1000/100 ml (May-Sept.)	Not exceed PHS limits	Not specified	Monthly ave. 1000/100 ml daily value 2400/100 ml	Not specified
Turbidity	NOT SPECIFIED			≤ 50 JTV above background	Not specified
Toxic substances	Free from substances which render water unsuitable for water contact sports	≤ 1/10 48 hr. TLM	≤ 1/10 48 hr. TLM	Free from substances toxic or harmful to humans, animals, or aquatic life	Not specified
Taste, Odor & color producing substances	Included w/toxic substances	No amount that will injure aquatic life, impair marketability or palatability or unreasonably affect aesthetic use value.		No amount sufficient to create a nuisance.	No amount that will interfere with classified use.

* Complete criteria description in Appendix B.

DISCUSSION OF STUDY RESULTS

STUDY METHODS

To comply with recommendations of the January 1972 Perdido Bay Enforcement Conference Progress Meeting, a field survey was conducted during June 5-16, 1972. The survey was designed to determine waste reductions resulting from the installation of additional secondary treatment units at the Pensacola Mill and to characterize wastes discharged into Elevenmile Creek.

Twenty-four-hour composite samples were collected with automatic samplers from each mill's outfall and at the influent and effluent of each unit within the treatment system (Table II). Bacteriological samples were collected on three separate days from the primary settling pond influent and final discharge into Elevenmile Creek. Samples were collected hourly for 12 hours each day and composited every three hours for analysis. Flows were determined at each waste sampling location by direct measurements, differences, or company records. Analytical methods were in accordance with either Standard Methods for Examination of Water and Wastewater, 13th Edition, or EPA Manual of Methods for Chemical Analyses of Water and Wastes, 1971. Appendix B contains a detailed discussion of sampling and analytical methods.

A study to determine the extent of short circuiting in the wastewater treatment system was conducted by dumping Rhodamine WT dye at the plant influent and timing passage of dye through each treatment pond. Serco automatic samplers were set to collect individual hourly samples at

TABLE II
ST. REGIS PAPER COMPANY
STATION LOCATIONS AND ANALYSES REQUIRED

EPA Sta. No.	Sample Location	Analyses Required	Sampling Frequency	Type Sampler
SR-1	No. 1 Ditch (Bleached)	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*	24-Hr. Composite for 10 Days	Company (Paddle Wheel)
SR-2	No. 2 Ditch (Unbleached)	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*	24-Hr. Composite for 10 Days	Company (Paddle Wheel)
SR-3	Influent to Primary Pond	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds,* Organic Scan, Phenols	24-Hr. Composite for 9 Days	Company (Paddle Wheel)
SR-4	Discharge From Primary Pond	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*, Settleable Solids	24-Hr. Composite for 10 Days	Company (Paddle Wheel)
SR-5	Effluent From No. 1 Pond	pH, Temp., BOD_5, TOC, COD,* Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*	24-Hr. Composite for 7 Days	Sigmamotor
SR-6	Effluent From No. 2 Pond	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*	24-Hr. Composite for 7 Days	Sigmamotor
SR-9	Effluent From No. 3 Pond	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*	24-Hr. Composite for 10 Days	Protech
SR-7	Final Effluent	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*, Settleable Solids, TKN, NH_3, NO_2-NO_3, Total P, Total and Fecal Coliform, Organic Scan, Phenols	24-Hr. Composite for 10 Days	Company (Paddle Wheel)
SR-8	Raw Water (Well)	pH, Temp., BOD_5, TOC, COD*, Tot. Susp. Sol., Tot. Vol. Susp. Sol., Color, Lignin-Like Compounds*, TKN, NH_3, NO_2-NO_3, Total P, Organic Scan, Phenols	Twice During Study	Grab

*COD and Lignin-Like compounds were analyzed from composites (grab) collected every other day, i.e., 4 times in 7 days.

Stations SR-4, SR-5, SR-7, and SR-9. An American Instruments fluoromicrophotometer was used to measure the relative dye concentrations at each sample location. A more detailed discussion of the dye tracer study is presented in the Discussion of Study Results.

GENERAL DISCUSSION

Study results show that wastewater pollutants have been significantly reduced by source controls and improved treatment at the Pensacola Mill. The mill is in compliance with conference recommendations relative to BOD_5 loads and settleable solids and treatment requirements. Table III contains a summary of average wastewater concentrations and loads for each parameter measured.

During the survey, daily mill production averaged 830 tons of pulp (543 tons of unbleached and 287 tons of bleached) and 785 tons of finished product. Annual average daily pulp and finished product production is 900 and 850 tons per day respectively.(3) Daily product production during the 1970 and 1971 surveys were 885 and 870 tons, respectively.

Production accounts for an average discharge of 25.9 MGD into the collection system. Expansion has resulted in essentially two mills with two separate collection systems. Wastewater streams from the No. 1 and No. 2 mill combine prior to discharging into the primary settling pond. Approximately 15.2 MGD of wastewater drains into Mill No. 1 ditch (Station SR-1) from the paper machines, recovery area, evaporator area, turbine room, screening area, blow tank, digesters, caustic room, turpentine overflow and bleach plant. Wastewater discharges into Mill No. 2 ditch (Station SR-2) averaged 9.16 MGD and are composed primarily

TABLE III

DATA SUMMARY
ST. REGIS PAPER COMPANY
JUNE 1972

Station		Flow	pH	Temp	BOD_5	TOC	COD	Residue: Total NFLT	Residue: Vol. NFLT	Residue: Settleable	Lignin	Color	Nitrogenous Compounds-N: TKN	Nitrogenous Compounds-N: NH_3	Nitrogenous Compounds-N: NO_2-NO_3	Total Phos-P	Coliform: Total	Coliform: Fecal	Phenols
SR-1	Avg Conc*	15.2	6.9	38.5	106	151	481	170	107	--	59	1,011	--	--	--	--	--	--	--
	Avg Load				13,400	19,100	61,000	21,600	13,600		7,500								
SR-2	Avg Conc	9.16	11.2	40.2	366	447	1,473	520	212	--	138	1,761	--	--	--	--	--	--	--
	Avg Load				28,000	34,100	112,500	39,700	16,200		10,500								
SR-3	Avg Conc	25.9	9.5	39.0	210	264	814	228	139	--	91	1,294	--	--	--	--	19,000	790	1,270
	Avg Load				45,000	57,500	175,000	49,200	30,000		19,600								274
SR-4	Avg Conc	25.8	8.6	35.8	196	215	669	79	56	0.5-<0.5	99	1,200	--	--	--	--	--	--	--
	Avg Load				42,200	46,300	144,000	17,000	12,000		21,300								
SR-5	Avg Conc	13.04	7.9	33.0	59	167	512	111	76	--	86	900	--	--	--	--	--	--	--
	Avg Load				6,400	18,200	55,700	12,100	8,300		9,350								
SR-6	Avg Conc	13.04	7.9	32.0	48	148	459	58	39	--	86	970	--	--	--	--	--	--	--
	Avg Load				5,200	16,100	49,900	6,300	4,200		9,350								
SR-9	Avg Conc	26.3	8.0	32.0	22	134	394	58	35	--	75	1,120	--	--	--	--	--	--	--
	Avg Load				4,820	29,400	86,400	12,700	7,700		16,500								
SR-7	Avg Conc	28.6	8.0	29.8	17	122	352	24	12	<0.5	73	1,100	4.0	1.01	0.56	0.94	12,000	230	30
	Avg Load				4,050	29,300	83,400	5,720	2,860		17,300		950	240	134	220			7
SR-8	Avg Conc	--	6.0	--	0.2	<1	<50	<5	<5	--	<0.2	<5	<0.05	<0.01	0.1	<0.01	--	--	45

* Concentrations in mg/l except phenols which is µg/l; pH - units, color - Pt-Co Units, Settleable Solids - ml/l, coliforms - MPN/100 ml (log mean); Loads in lbs/day

of discharges from the tall oil area, caustic room, septic tank, turpentine overflow, evaporator area, screening room, turbine room, blow tanks, water treatment building, bag plant and paper machines. Discharges from the west screen room and woodyard are not monitored at sampling stations SR-1 and SR-2 but are included in the total influent into the primary settling pond. Although woodyard drainage normally varies between 0.7 and 1.5 MGD, while west screen room discharges range between 0.15 and 0.4 MGD, daily flows into the primary pond fluctuated very little.

The volume of wastewater discharged into Elevenmile Creek averaged 28.6 MGD -- an increase of 2.7 MGD over the volume of wastewater flowing into the treatment system. The only noticeable infiltration into the treatment system was from swamp drainage and spring-fed streams which contributed about 2 MGD to Pond No. 4. The treatment system is located in the floodplain of the plant drainage basin, and surface runoff can significantly increase the volume of water flowing through the treatment system. However, only a trace amount of precipitation occurred at the mill during the study. Temperatures were seasonal, ranging from 70-95° with daily averages from 75-85°.

ANALYTICAL RESULTS

Temperature

The temperature of the wastewater from each mill averaged about 39°C. A 3°C drop occurred through the primary settling pond with approximately a 1°C decrease through each succeeding pond. The final discharge into Elevenmile Creek had a temperature of 30°C. The temperature of the receiving waters, Perdido Bay, ranged between 27 and 28°C.

pH

The pH of the effluent from Mill No. 1 was neutral; effluent pH from Mill No. 2 was very alkaline at 11.2. After combining, the alkalinity was partially neutralized and the primary settling basin influent had a pH of 9.5; the effluent was 8.6. Aeration ponds 1 and 2 further lowered the pH to 8.0, and this was the pH of the final discharge.

Biochemical Oxygen Demand

Study results indicate that the company is complying with enforcement conference BOD_5 requirements of not more than 51,000 pounds per day before treatment, a 90 percent reduction, and not more than 5,100 pounds per day in the final discharge.

The raw waste load generated in the plant contained an average BOD_5 concentration of 210 mg/l, or a waste load of 45,000 pounds per day. Thirty percent of the BOD_5 (13,400 pounds per day) came from Mill No. 1; 62 percent (28,000 pounds per day) originated in No. 2 mill; the remainder was from woodyard drainage and the west screen room.

There have been significant in-plant reductions since the November 1970 survey. The untreated BOD_5 of 45,000 pounds per day determined during this survey was:

- 28,700 pounds per day less than the BOD_5 measured during the December 1970 survey;
- 43,800 pounds per day less than the BOD_5 recorded during the September 1969 survey, and
- 17,500 pounds per day greater than the values measured during the 3 days of sampling during June 1971.

The Water Resources Research Institute publication reports average BOD_5 loads for unbleached and bleached pulp and paper mills in the southeast to be 43 and 79 pounds per ton of production.(4) Using the average waste load values, a raw load of 43,300 pounds per day of BOD_5 was calculated; this is essentially the same as the measured raw load (45,000 pounds per day).

Effluent discharged into Elevenmile Creek contained 17 mg/l of BOD_5 or load of 4,050 pounds per day -- a load reduction of 91 percent.[1/] Only seven percent of the BOD_5 was removed in the primary settling pond. Aeration ponds 1 and 2 provided the greatest treatment reductions (Table IV). Figure 2 shows the loads discharged from each pond in the treatment system.

Total Organic Carbon

The average raw total organic carbon (TOC) load generated in the plant was 57,500 pounds per day (264 mg/l) of which 19,100 pounds per day came from No. 1 mill, 34,100 pounds per day from No. 2 mill, and 4,300 pounds per day from woodyard drainage and the west screen room. The TOC reduction in the primary settling pond was only 19 percent; however, the TOC in the final discharge was 29,300 pounds per day (122 mg/l) -- a 49 percent reduction. The primary settling basin reduced the TOC load by 19 percent. Increasing the retention time through this basin should increase the TOC removal.

The discharge into Elevenmile Creek is 13,200 lbs per day greater

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1/ Because of differences in influent and effluent wastewater volumes, percent reductions are calculated from influent and effluent loads.

TABLE IV

WASTEWATER TREATMENT EFFICIENCIES
ST. REGIS PAPER COMPANY
PENSACOLA MILL

June 1972

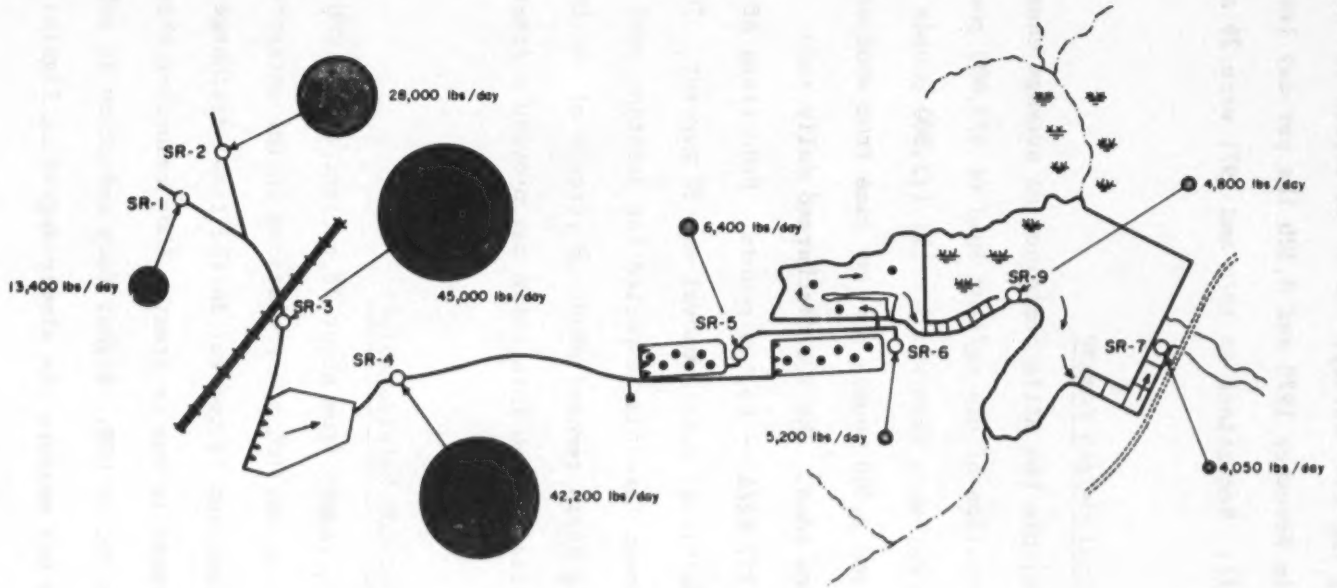
	Percent Reduction						
				Residue			
Treatment Unit	BOD_5	TOC	COD	Total NFLT	Vol NFLT	Lignin	Color
Primary Pond	7	19	18	65	60	(-)[1] 9	7
No. 1 Aeration Pond	33	9	9	(-) 7	(-) 8	7	11
No. 2 Aeration Pond	35	12	13	4	6	7	10
No. 3 Aeration Pond	15	8	11	12	16	11	(-) 15
No. 4 Pond	2	1	1	14	16	(-) 4	2
TOTALS:	91[2]	49	52	88	90	12	15

NOTE: 1/ (-) indicates increase.

2/ Total percent reduction based on loads.

FIGURE 2

AVERAGE 5-DAY BIOCHEMICAL OXYGEN DEMAND LOADS
PENSACOLA MILL TREATMENT SYSTEM



U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV

ST. REGIS PAPER COMPANY
WASTEWATER SURVEY
JUNE, 1972

SURVEILLANCE AND ANALYSIS DIVISION
ATHENS GEORGIA

than that discharged during the 1969 survey, but it is 19,500 lbs per day less than that discharged in November 1970 and 8,300 lbs per day less than that discharged in June 1971. Reductions in 1970 and 1971 were 29 and 21 percent, respectively.

Chemical Oxygen Demand

The wastes generated within the mills contained an average chemical oxygen demand (COD) concentration of 814 mg/l or load of 175,000 pounds per day; 61,000 pounds per day were from No. 1 mill; 112,500 pounds per day were from No. 2 mill; and 1,500 pounds per day came from woodyard drainage and the west screen room. The TOC discharged daily into Elevenmile Creek averaged 352 mg/l -- 83,400 pounds. Reductions of COD closely paralleled TOC reductions; total removal was 52 percent. This reduction was 10 to 30 percent less than expected for aeration pond treatment. The primary settling basin removed about 18 percent of the COD load. Increasing the retention time through this basin may provide a greater reduction.

BOD_5-TOC-COD Relationships

Concentrations of BOD_5 ranged from about 25 percent of the COD concentrations and 80 percent of the TOC concentrations in the untreated wastewater to about 5 percent and 15 percent in the final discharge (Table 5). The ratio decrease is due to greater BOD_5 reduction through the system than for either TOC or COD. Higher BOD_5 reduction is achieved because the BOD_5 test does not measure the slowly-degrading lignins which the other tests do include.

TABLE V

BOD_5 - TOC - COD RELATIONSHIPS

ST. REGIS PAPER COMPANY

JUNE 1972

	BOD_5:TOC	BOD_5:COD	TOC:COD
Untreated Wastewater			
	.71	.25	.36
	.80	.28	.31
	.62	.27	.45
	.93	.25	.30
	.89	.28	.28
	.99		
Average	.82	.27	.34
Primary Settling Basin Effluent			
	.72	.22	.30
	.77	.28	.27
	.68	.29	.42
	1.07	.32	.26
	1.12	.30	.33
	.94	.32	.29
	1.03		.31
	1.02		
Average	.92	.29	.31
Aeration Pond No. 1 Effluent			
	.47	.15	.32
	.34	.11	.36
	.36	.10	.31
	.28		
	.38		
Average	.37	.12	.31
Aeration Pond No. 2 Effluent			
	.22	.08	.34
	.28	.12	.30
	.38	.12	.31
	.31		.27
	.42		
Average	.32	.11	.30
Aeration Pond No. 3 Effluent			
	.13	.04	.34
	.22	.06	.35
	.16	.06	.40
	.18	.05	.36
	.17	.05	.23
	.23		.34
	.15		.35
	.14		
Average	.17	.05	.34
Final Discharge			
	.14	.05	.34
	.14	.04	.35
	.13	.05	.35
	.14	.04	.34
	.15	.06	.35
	.13		
Average	.14	.05	.35

The BOD_5:TOC and BOD_5:COD ratios were not constant through the entire treatment system but were relatively stable in any specific pond following the primary settling pond. The TOC:COD ratio was essentially constant through the entire treatment system; it increased slightly with increased degrees of treatment. The correlation between BOD, TOC, and COD in the final effluent was very good. The ratio of any two of these parameter values could be used to calculate the approximate value of the missing parameter.

Lignin-like Compounds

Mill production generated about 19,600 pounds per day of lignin-like compounds; 7,500 pounds per day were from Mill No. 1; 10,500 pounds per day came from Mill No. 2; 1,600 pounds per day were from woodyard drainage and the west screen room. An additional 2,600 pounds per day were contributed by the waste treatment system; flow across the highly-concentrated sludge in the primary settling basin leached 1,700 pounds per day into the wastewater, and swamp drainage into the final biological pond added an additional 900 pounds per day. The net reduction through the system measured from the primary settling basin to the final discharge at King's Field Road was 12 percent; however, because of additions within the system, the three aeration ponds actually provided a 25 percent reduction (Table IV). The discharge contained 17,300 pounds per day of lignin-like compounds.

Color

The color concentration of 1290 Pt.-Co. Units detected in the pond influent reflect an excessive amount of black liquor lost to the waste stream.

Figure 3 shows the color level at each in-plant sampling station. Color increases observed in the No. 3 aeration pond may have been due to leaching. This pond was placed in operation prior to 1962 and served as a settling basin in the old treatment system.

Color removal during this survey was 15 percent with 1100 Pt.-Co. Units in the discharge. In June 1971, a 12 percent color reduction was calculated with 770 units of color observed in the final effluent.

The addition of aerators to the treatment system has significantly increased the reductions of all parameters except color.

Nitrogen and Phosphorus

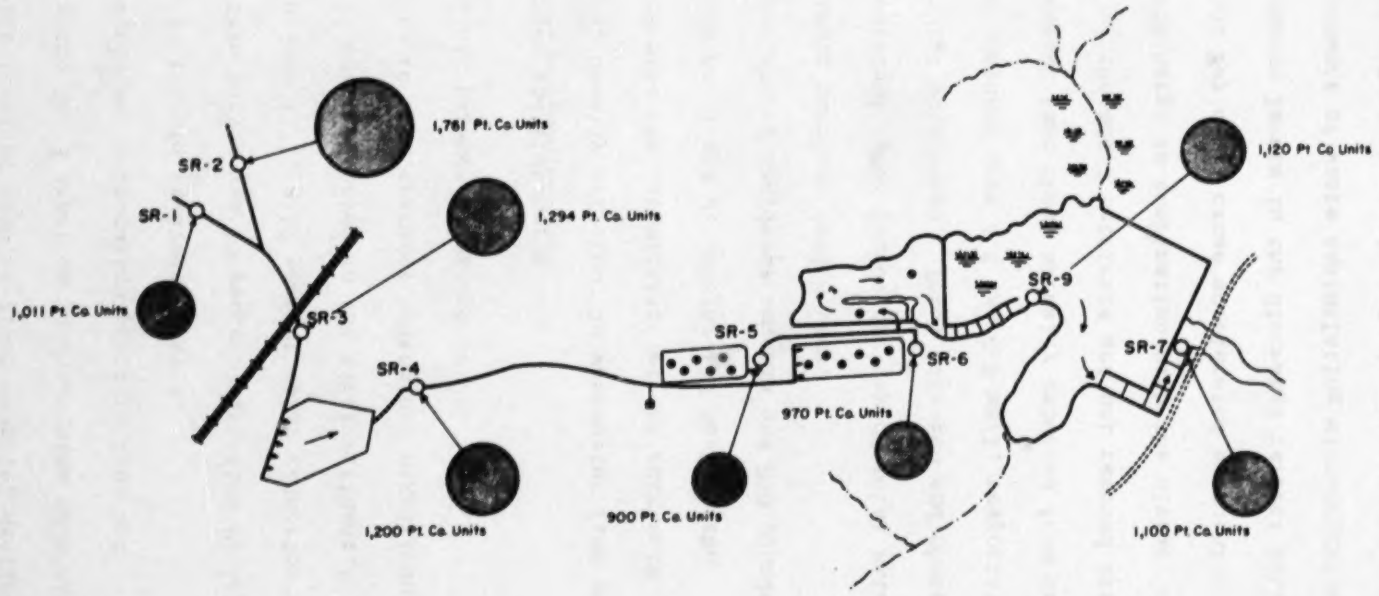
Nitrogen and phosphorus, usually deficient in wastewater from paper mills, were measured to determine the assimilation of the nutrients added ahead of aeration ponds No. 1 and 2. During the survey, the company used 1,400 pounds per day of anhydrous ammonia and 850 pounds per day of phosphoric acid in their nutrient feed system.

The final discharge contained 1,080 pounds per day of total nitrogen and 220 pounds per day of total phosphorus. Total nitrogen and phosphorus concentrations in the final effluent were 4.6 and 0.9 mg/l, respectively. These concentrations are greater than those normally expected from kraft mills, indicating that all of the added nutrients are not removed effectively. This significant nutrient discharge in combination with the already significant carbon level in Perdido Bay could cause accelerated eutrophication.

The nitrogen and phosphorus levels in the discharge reflect both unused nutrients and the presence of waste assimilating microorganisms which contain both nutrients. Optimal nutrient feed concentrations and

FIGURE 3

AVERAGE COLOR
PENSACOLA MILL TREATMENT SYSTEM



U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IV
ST. REGIS PAPER COMPANY WASTEWATER SURVEY JUNE, 1972
SURVEILLANCE AND ANALYSIS DIVISION ATHENS GEORGIA

26

methods to reduce the volume of discharged microorganisms are necessary. Addition of the proposed aeration pond to achieve greater aerating efficiency may fulfill the latter need.

Residue -- Settleable, Total Nonfilterable and Volatile Nonfilterable (Settleable, Total and Volatile Suspended Solids)

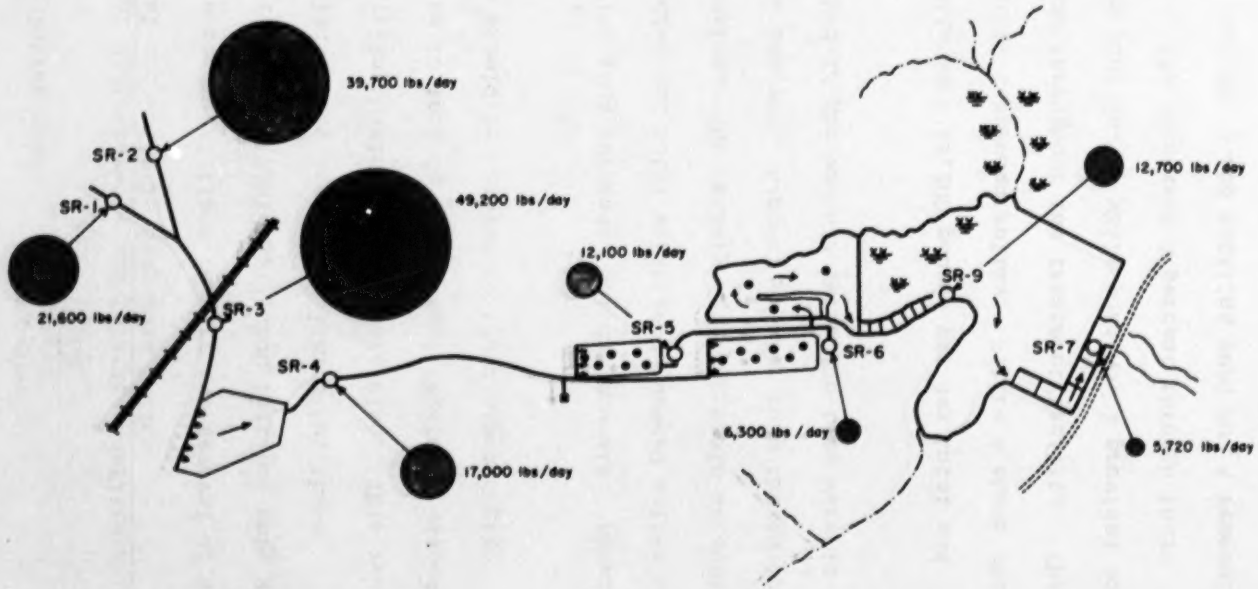
Enforcement conference recommendations require the removal of all settleable solids. Analytical data (Table III) show that not only were the effluent settleable solids below detectable limits but those measured in the primary settling basin effluent were also. This recommendation should be modified to include a statement regarding suspended solids -- Suspended solids should be removed to the maximum degree feasible.

The company is achieving good suspended solids removals. About 90 percent of the total suspended and total volatile suspended solids were removed in the treatment system. The primary settling basin accounted for about two-thirds of the removal. Removal greater than the 60-65 percent might be accomplished if the basin's retention time were increased.

Raw loads from the mills were 49,200 pounds per day total and 30,000 pounds per day volatile suspended solids. Figure 4 shows the total suspended solids loads throughout the treatment facility. There was an increase in aeration pond No. 1, while pond No. 2 provided some reduction. Net suspended solids increased 3 percent through these parallel ponds. Aeration pond No. 3 and settling pond No. 4 removed about 12 and 14 percent additional suspended solids. The final discharge

FIGURE 4

AVERAGE SUSPENDED SOLIDS LOAD
PENSACOLA MILL TREATMENT SYSTEM



U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IX
ST. REGIS PAPER COMPANY WASTEWATER SURVEY JUNE, 1972
SURVEILLANCE AND ANALYSIS DIVISION ATHENS GEORGIA

contained 5,720 pounds per day of total suspended solids and 2,860 pounds per day of volatile suspended solids.

Organic Scan

Gas chromatograph/mass spectrometric analyses on the untreated and treated wastewater showed organics typical of paper mill wastes. The organics were constituents of wood or degradation products of wood constituents (Table VI). Treatment reduced the foam-causing ingredients, fatty and resin acids, by 66 percent; concentration reductions were from 3500 µg/l to 1200 µg/l. Unfortunately, EPA data are not available to determine the fatty and resin acid reductions resulting from in-plant controls. Phenolics were reduced from 2000 µg/l to below detectable limits. A scan of the raw water source (Station SR-8) did not reveal the presence of any organic compounds in concentrations greater than 10 µg/l.

It is interesting to note that the colorimetric phenol analyses showed phenols present both in the final discharge and the raw water. Apparently, either colorimetric positive interferences were present (as the GC/MS method is a more accurate phenol detector) or phenolic organic present was not extractable for GC/MS analysis.

Bacteriology

Data showed only a minor amount of fecal contamination in the wastewater discharged into Elevenmile Creek from the Pensacola Mill. A schematic of waste sources within the mill shows a septic tank discharge into mill No. 2 ditch; however, this discharge is apparently minor and does not significantly elevate the fecal coliform count in the primary

TABLE VI
ORGANIC COMPOUNDS
ST. REGIS PAPER COMPANY
PENSACOLA MILL
JUNE 1972

Organic Compound	Chemical Class	Concentration (µg/l) Influent to Primary Settling Basin (SR-3)	Concentration (µg/l) Final Discharge From Treatment System (SR-7
palmitic acid	fatty acid	140	30
stearic acid	fatty acid	75	26
oleic acid	fatty acid	560	77
pimaric acid	resin acid	420	230
dehydroabietic acid	resin acid	1,400	510
abietic acid	resin acid	760	300
neoabietic acid	resin acid	120	*
beta-ocimene	terpene hydrocarbon	20	*
beta-pinene	terpene hydrocarbon	20	*
fenchyl alcohol	alcohol	41	*
camphor	ketone	14	*
borneol	alcohol	47	*
alpha-terpineol	alcohol	280	*
c-methoxy-phenol	phenol	44	*
vanillin	aldehyde & phenol	770	*
acetovanillin	ketone & phenol	600	*
syring-aldehyde	aldehyde & phenol	570	*

* Not detected in effluent

basin influent. The untreated waste (Station SR-3) had a geometric mean total and fecal coliform bacteria density of 19,000 and 790/100 ml, respectively (Table III). The coliform density of untreated wastes fluctuated dramatically during the 12-hour sampling period with total and fecal counts varying from 330 to greater than 240,000/100 ml and greater than 20 to 7,000/100 ml, respectively.

Bacterial density fluctuations were less dramatic in the final treated effluent (Station SR-7) with total coliform counts ranging from 54,000 to 1,300/100 ml and fecal coliform counts varying between 1,300 and 70/100 ml. Treated effluent had a mean total and fecal coliform density of 12,000 and 230/100 ml, respectively. The difference in coliform concentrations between the untreated and treated waste represents a 37 and 71 percent treatment reduction of total and fecal coliform, respectively.

One Salmonella serotype was isolated from the final effluent and identified as S. give.

SHORT CIRCUITING STUDY

A short circuiting study was conducted by dumping 8 gallons of Rhodamine WT dye at Station SR-3 (Figure 1) at 1900 on June 9 and measuring the time until the first trace was detected and until either a peak or apparent peak was detected at the various sample stations.

Because of sorption of the dye by the foam, photochemical decay, and other factors, a material balance would be extremely difficult, if not impossible, and therefore was not attempted.

Approximate travel times through the treatment system were:

Sample Location	Company Name	Date-Time Initial Trace	Time from Dye Dump	Date-Time Peak	Time from Dump
SR-4	Basin Outlet	6/9 2200	3 hrs.	6/9 2400	5 hrs.
SR-5	Discharge - No. 1 Aeration Pond	6/10 0100	6 hrs.	6/10 1900	24 hrs.
SR-9	Discharge - No. 3 Aeration Pond	6/10 1500	20 hrs.	6/11 0900	38 hrs.
SR-7	King's Field Rd. (Discharge from final pond)	6/10 2400	29 hrs.	6/12 0200	55 hrs.

The theoretical retention times based on pond volume are:

Pond	Volume (Million Gallons)	Flow	Theoretical Retention Time (Hours)	Cumulative Time (Hours)
Primary Settling	31.3	25.1	30	30
Aeration Pond No. 1	18.2	12.9 1/	34	64
Aeration Pond No. 3	28.5	26.6 2/	26	90
Final Pond No. 4	32.1	29.3 3/	26	116

1/ 25.7 MGD is the average of the flows on June 10 and 11 through Ponds 1 and 2. A splitter box ahead of the ponds diverted 12.9 MGD into each pond.

2/ 27.1 MGD is the average on June 10 and 11.

3/ 29.3 is the average on June 10-12.

Extreme short circuiting is evident in the primary settling basin. Some short circuiting may occur in the aeration basins, but very little is apparent in the final settling pond. However, there is enough retention time in the system to provide high BOD_5 and suspended solids removals. Further removal of these and other parameters may be increased with baffle systems and/or realignment of the aerators.

Prior to the dye study, it was thought that foam in the aeration ponds would either sorb the dye and make detection difficult or impossible or that windblown, dyed foam might provide incorrect, short circuiting results. Because of this, the dye was to have been dumped when there was little or no foam; however, this was not possible. The foam depth was usually less during the day than at night. Therefore, the dye was dumped in the evening with the assumption that it would pass through the primary settling pond during the night and enter the aeration ponds the following day. This did not happen; the dye peaked through the settling basin in five hours, and by daylight it was completely mixed throughout the first two aeration ponds. Therefore, dispersion studies (visual or instrumental) were not possible in the aeration ponds.

REFERENCES

1. Effects of Pollution on Water Quality, Perdido River and Bay, Alabama and Florida, U. S. Department of the Interior, Federal Water Pollution Control Administration, Southeast Water Laboratory, Athens, Georgia, January 1970.

2. Supplement to Effects of Pollution on Water Quality, Perdido River and Bay, Alabama and Florida, Environmental Protection Agency, Southeast Water Laboratory, Athens, Georgia, February 1971.

3. Southern Pulp and Paper Manufacturer, Perry H. Koplik and Sons, Inc., New York, N. Y., October 1971.

4. Survey of Water Utilization and Waste Control Practices in the Southern Pulp and Paper Industry, Water Resources Research Institute, University of North Carolina, June 1970.

APPENDICES

APPENDIX A

PROJECT PERSONNEL

Dick Baird - Sanitary Engineer

Tom Bennett - Chemist

Jerry Burger - Engineering Aid

Bobby Carroll - Microbiologist

Ralph Gentry - Microbiologist

Steve Hall - Sanitary Engineer

Wade Knight - Chemist

Pat Lawless - Chemist

Tom Sack - Physical Science Technician

Eddie Shollenberger - Engineering Technician

Ron Weldon - Biologist

APPENDIX B

SAMPLING PROCEDURES AND ANALYTICAL METHODS
ST. REGIS PAPER COMPANY

SAMPLING PROCEDURES

Twenty-four hour composite samples were collected at eight locations (SR-1, SR-2, SR-3, SR-4, SR-5, SR-6, SR-7, and SR-9) within the company's waste treatment facilities for seven consecutive days. For three additional days, 24-hour composites were collected at six locations (SR-5 and SR-7 excluded). The mill's raw water source (SR-8) was grab sampled twice during the study. Company automatic samplers (paddle wheel type) were used at stations SR-1, 2, 3, 4, & 7; SR-4 & 7 were refrigerated. EPA automatic samplers (Sigmamotor or Protech) were used at Stations SR-5, 6, and 9; each was refrigerated. Analyses required on all composites and the raw water grab were pH, temperature, BOD_5, TOC, COD, total suspended solids, total volatile suspended solids, lignin-like compounds and color. Nitrogen series and total phosphorus parameters were analyzed on samples collected from Stations SR-8 and SR-7 (raw water and final discharge). Settleable solids determinations were made on samples collected from the primary settling basin and the final discharge.

Grab samples for total and fecal coliform analyses were collected periodically from the influent to (Station SR-3) and effluent from (Station SR-7), the treatment system. On 3 days, grab samples were collected hourly for 12 hours and composited every three hours. Samples for phenolic and organic scan analyses were grabbed once daily from Stations SR-3 and 7.

All samples were refrigerated during transport to the field laboratory located at the Florida State Board of Health in Pensacola.

Temperatures were measured in the field; pH was measured in the field laboratory.

Flows were measured at Stations SR-2, 4, 7, and 9. Flows were determined for Stations SR-1 and 3 by differences and/or company records. Company and EPA gaging of the inlet ditches to aeration ponds 1 and 2 yielded flows for Stations SR-5 and 6.

ANALYTICAL METHODS

The following analytical methods were used by EPA personnel:

Parameter	Method	Reference
Biochemical Oxygen Demand	Winkler DO, 5-Day	1,2
Chemical Oxygen Demand	Acid-dichromate Oxidation	2
Total Organic Carbon	Carbon Analyzer	2
Suspended Solids	Gravimetric	1
Color	Visual Against Co.-Pt. Standard	1
Lignin-like Compounds	Tungsto-molybdo-phosphoric Acid Method	1
Total Kjeldahl Nitrogen	Automated Phenolate Method	2
Ammonia	Automated Phenolate Method	2
Nitrate-Nitrite	Copper-cadmium Reduction, Automated	2
Phosphorus	Ascorbic Acid Method	2
Settleable Solids	Volumetric	1
pH	Electrometric	1
Total Coliform	MPN	1
Fecal Coliform	MPN	1
Organic Scan	SEWL	-

1. Standard Methods for Examination of Water and Wastewater, 13th Edition, 1971.
2. EPA Manual of Methods for Chemical Analyses of Water and Wastes, 1971.

APPENDIX C

WASTE SAMPLING DATA

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

AGENCY PRIMARY STATION	SECONDARY	SECONDARY	STATION LOCATION	STATE	MINOR BASIN	
11135000						
640036	SR-01	F-033-A12	ST. REGIS PAPER CO.-NO. 1 DITCH	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640039	SR-02	F-033-A13	ST. REGIS PAPER CO.-NO. 2 DITCH	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640042	SR-03	F-033-A14	ST. REGIS PAPER CO-PRIMRY PD INF	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640045	SR-04	F-033-A15	ST. REGIS PAPER CO-PRIMRY PD EFF	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640048	SR-05	F-033-A16	ST. REGIS PAPER CO-NO 1 POND EFF	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640051	SR-06	F-033-A17	ST. REGIS PAPER CO-NO 2 POND EFF	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640054	SR-07	F-033-A18	ST. REGIS PAPER CO.-FINAL EFF.	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640057	SR-08	F-033-A19	ST. REGIS PAPER CO.-RAW WATER	FLORIDA	PERDIDO RIVER BASIN	SPECIAL
640060	SR-09	F-033-A20	ST. REGIS PAPER CO-NO 3 POND EFF	FLORIDA	PERDIDO RIVER BASIN	SPECIAL

C 1

PARAMETER	DESCRIPTION
50050	FLOW IN CONDUIT OR THRU A TREATMENT PLANT (MGD)
00080	COLOR (PLATINUM-COBALT UNITS)
00310	BIOCHEMICAL OXYGEN DEMAND (MG/L, 5 DAY - 20DEG C)
00340	CHEMICAL OXYGEN DEMAND, .25N K2CR2O7 (MG/L)
00403	PH (STANDARD UNITS) LAB
00530	RESIDUE, TOTAL NONFILTRABLE (MG/L)
00535	RESIDUE, VOLATILE NONFILTRABLE (MG/L)
00680	CARBON, TOTAL ORGANIC (MG/L AS C)
32240	TANNIN AND LIGNIN (MG/L)
00010	TEMPERATURE, WATER (DEGREES CENTIGRADE)
31505	COLIFORM,TOT,MPN,CONFIRMED TEST,35C (TUBE 31506)
31615	FECAL COLIFORM,MPN,EC MED,44.5C (TUBE 31614)
32730	PHENOLS (UG/L)
00545	RESIDUE, SETTLEABLE (ML/L)
00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)
00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)
00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME		DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L	00535 RESIDUE VOL NFLT MG/L	00680 T ORG C C MG/L	32240 TANNIN LIGNIN MG/L	00010 WATER TEMP CENT
SR-01	720605	1410					15.500									36.0
SR-01	720606	0745					15.500									41.5
SR-01	720605	0830	(C)	720606	0800		15.500	700	108.0	426	8.0	78	62	135.0	47	
SR-01	720607	0730					15.600									38.0
SR-01	720606	0800	(C)	720607	0730		15.600	800			5.3	100	84	164.0		
SR-01	720607	0730	(C)	720608	0740		15.500	700		414	6.4	140	120	116.0	52	
SR-01	720608	0740	(C)	720609	0725		15.000	700	86.0		5.0	110	100	176.0		
SR-01	720609	0725	(C)	720610	0725		14.800	1300	114.0	560	8.2	390	190	198.0	79	
SR-01	720610	0725	(C)	720611	0725		15.600	1300	100.0		7.3	160	140	134.0		
SR-01	720611	0725	(C)	720612	0735		15.600	1300	102.0	547	6.6	150	120	173.0	71	
SR-01	720613	0740	(C)	720614	0740		14.400	1200	118.0	501	7.5	170	80	80.0	55	
SR-01	720614	0740	(C)	720615	0730		14.400	1100	110.0	472	7.4	150	82	190.0	56	
SR-01	720615	0730	(C)	720616	0715		15.300		115.0	449	7.5	250	90	140.0	56	
NUMBER							13	9	8	7	10	10	10	10	7	3
MAXIMUM							15.600	1300	118.0	560	8.2	390	190	198.0	79	41.5
MINIMUM							14.400	700	86.0	414	5.0	78	62	80.0	47	36.0
MEAN							15.254	1011	106.6	481	6.9	170	107	150.6	59	38.5
SR-02	720605	1400					9.130									36.5
SR-02	720606	0700					9.130									42.0
SR-02	720605	0800	(C)	720606	0730		9.130	3500	446.0	2630	11.9	550	240	706.0	310	
SR-02	720607	0720					9.270									42.0
SR-02	720606	0730	(C)	720607	0720		9.270	2250			12.0	980	400			
SR-02	720607	0720	(C)	720608	0730		9.200	2600		1670	12.0	840	320	532.0	68	
SR-02	720608	0730	(C)	720609	0720		8.890	1400	362.0		11.4	340	180	492.0		
SR-02	720609	0720	(C)	720610	0720		8.630	900	301.0	1130	11.0	280	200	352.0	110	
SR-02	720610	0720	(C)	720611	0720		9.340	1600	430.0		11.3	270	170	491.0		
SR-02	720611	0720	(C)	720612	0730		9.500	1300	270.0	1050	10.2	290	140		100	
SR-02	720613	0730	(C)	720614	0730		9.400	1300	300.0	940	10.8	550	86	300.0	97	
SR-02	720614	0730	(C)	720615	0720		9.000	1400	386.0	1450	10.9	570	140	260.0	170	
SR-02	720615	0720	(C)	720616	0710		9.200	1360	430.0	1440	10.4	530	240	440.0	110	
NUMBER							13	10	8	7	10	10	10	8	7	3
MAXIMUM							9.500	3500	446.0	2630	12.0	980	400	706.0	310	42.0
MINIMUM							8.630	900	270.0	940	10.2	270	86	260.0	68	36.5
MEAN							9.161	1761	365.6	1473	11.2	520	212	446.6	138	40.2

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L	00535 RESIDUE VOL NFLT MG/L
SR-03	720605	1415				26.300						
SR-03	720606	0800				26.300						
SR-03	720605	0830(C)	720606	0800		26.300	1250	223.0	879	9.5	220	150
SR-03	720606	1330				26.300						
SR-03	720606	0800(C)	720607	0735		26.500	1200			10.2	270	170
SR-03	720607	0635(C)	720607	0840		26.500						
SR-03	720607	1125				26.500						
SR-03	720607	0935(C)	720607	1125		26.500						
SR-03	720607	1230(C)	720607	1430		26.500						
SR-03	720607	1530(C)	720607	1730		26.500						
SR-03	720608	0640				26.400						
SR-03	720607	0735(C)	720608	0740		26.400	1600		970	10.4	390	220
SR-03	720608	0640(C)	720608	0840		26.400						
SR-03	720608	0935(C)	720608	1125		26.400						
SR-03	720608	1250(C)	720608	1440		26.400						
SR-03	720608	1535(C)	720608	1735		26.400						
SR-03	720608	0740(C)	720609	0755		25.500	1100	196.0		8.8	130	100
SR-03	720609	0835				25.100						
SR-03	720610	0735				25.100						
SR-03	720609	0755(C)	720610	0735		25.100	1400	194.0	693	9.4	190	130
SR-03	720611	0645				26.400						
SR-03	720610	0735(C)	720611	0645		26.400	1400	235.0		10.3	200	150
SR-03	720611	0647(C)	720611	0840		26.400						
SR-03	720611	0940(C)	720611	1140		26.400						
SR-03	720611	1410(C)	720611	1610		26.400						
SR-03	720611	1705(C)	720611	1800		26.400						
SR-03	720611	0645(C)	720612	0700		26.400	1000	205.0	772	8.3	100	78
SR-03	720612	0701				26.400						
SR-03	720614	0700(C)	720615	0700		24.500	1400	199.0	788	9.6	280	110
SR-03	720615	0700(C)	720616	0700		25.900		217.0	775	8.9	270	140
NUMBER						30	8	7	6	9	9	9
MAXIMUM						26.500	1600	235.0	970	10.4	390	220
MINIMUM						24.500	1000	194.0	693	8.3	100	78
MEAN						26.167	1294	209.9	813	9.5	228	139

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PENDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME		DATE	TIME	DEPTH	00680 T ORG C C MG/L	32240 TANNIN LIGNIN MG/L	00010 WATER TEMP CENT	31505 TOT COLI MPN CONF /100ML	31615 FEC COLI MPNECMED /100ML	32730 PHENOLS UG/L
SR-03	720605	1415							36.0	490	20K	
SR-03	720606	0800							41.0			3750
SR-03	720605	0830	(C)	720606	0800		314.0	88				
SR-03	720606	1330								330	40	
SR-03	720607	0735							39.0			
SR-03	720606	0800	(C)	720607	0735		238.0					
SR-03	720607	0635	(C)	720607	0840					24000	1300	
SR-03	720607	1125										1140
SR-03	720607	0935	(C)	720607	1125					7900	490	
SR-03	720607	1230	(C)	720607	1430					13000	90	
SR-03	720607	1530	(C)	720607	1730					18000	700	
SR-03	720607	0735	(C)	720608	0740		300.0	120				
SR-03	720608	0640	(C)	720608	0840					92000	4600	
SR-03	720608	1030										625
SR-03	720608	0935	(C)	720608	1125					35000	4900	
SR-03	720608	1250	(C)	720608	1440					92000	7000	
SR-03	720608	1535	(C)	720608	1735					240000L	1700	
SR-03	720608	0740	(C)	720609	0755		246.0					
SR-03	720609	0835										870
SR-03	720610	0735										1130
SR-03	720609	0755	(C)	720610	0735		314.0	89				
SR-03	720611	0645										740
SR-03	720610	0735	(C)	720611	0645		253.0					
SR-03	720611	0647	(C)	720611	0840					7000	1100	
SR-03	720611	0940	(C)	720611	1140					7900	700	
SR-03	720611	1410	(C)	720611	1610					160000	1700	
SR-03	720611	1705	(C)	720611	1800					240000L	3200	
SR-03	720611	0645	(C)	720612	0700		230.0	84				
SR-03	720612	0701										650
SR-03	720614	0700	(C)	720615	0700			88				
SR-03	720615	0700	(C)	720616	0700		220.0	78				
NUMBER							8	6	3	14	14	7
MAXIMUM							314.0	120	41.0	240000	7000	3750
MINIMUM							220.0	78	36.0	330	20	625
MEAN							264.4	91	38.7	66973	1967	1272

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L
SR-04	720605	1400				26.300					
SR-04	720606	0805				26.300					
SR-04	720605	0900	(C) 720606	0805		26.300	1400	167.0	769	9.1	38
SR-04	720607	0750				26.500					
SR-04	720606	0805	(C) 720607	0750		26.500	1100			9.2	74
SR-04	720607	0750	(C) 720608	0750		26.400	1100		698	8.5	80
SR-04	720608	0750	(C) 720609	0730		25.500	1400	203.0		9.4	92
SR-04	720609	0730	(C) 720610	0740		25.100	1100	200.0	701	8.2	60
SR-04	720610	0740	(C) 720611	0730		26.400	1300	224.0		8.8	100
SR-04	720611	0730	(C) 720612	0740		26.400	1100	196.0	675	7.8	84
SR-04	720613	0750	(C) 720614	0750		24.500	1100	186.0	589	8.8	70
SR-04	720614	0750	(C) 720615	0740		24.500	1200	188.0	620	8.0	120
SR-04	720615	0740	(C) 720616	0720		25.900		200.0	634	8.2	68
NUMBER						13	9	8	7	10	10
MAXIMUM						26.500	1400	224.0	769	9.4	120
MINIMUM						24.500	1100	167.0	589	7.8	38
MEAN						25.892	1200	195.5	669	8.6	79

STATION	DATE	TIME	DATE	TIME	DEPTH	00535 RESIDUE VOL NFLT MG/L	00680 T ORG C C MG/L	32240 TANNIN LIGNIN MG/L	00010 WATER TEMP CENT	00545 RESIDUE SETTLABLE ML/L
SR-04	720605	1400							35.0	
SR-04	720606	0805							37.0	
SR-04	720605	0900	(C) 720606	0805		26	232.0	96		
SR-04	720607	0750							35.5	
SR-04	720606	0805	(C) 720607	0750		62	213.0			1K
SR-04	720607	0750	(C) 720608	0750		64	190.0	130		1K
SR-04	720608	0750	(C) 720609	0730		64	263.0			1
SR-04	720609	0730	(C) 720610	0740		60	295.0	110		1K
SR-04	720610	0740	(C) 720611	0730		68	210.0			1K
SR-04	720611	0730	(C) 720612	0740		48	175.0	97		1
SR-04	720613	0750	(C) 720614	0750		52	197.0	90		
SR-04	720614	0750	(C) 720615	0740		68	182.0	86		
SR-04	720615	0740	(C) 720616	0720		52	195.0	86		
NUMBER						10	10	7	3	6
MAXIMUM						68	295.0	130	37.0	1
MINIMUM						26	175.0	86	35.0	1
MEAN						56	215.2	99	35.8	1

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME		DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L	00535 RESIDUE VOL NFLT MG/L	00680 T ORG C C MG/L	32240 TANNIN LIGNIN MG/L	00010 WATER TEMP CENT
SR-05	720605	1420					13.150									
SR-05	720606	0900					13.150									33.0
SR-05	720605	0900	(C)	720606	0900		13.150	800	74.0	490	8.3	140	96	156.0	73	32.0
SR-05	720607	0920					13.250									
SR-05	720606	0900	(C)	720607	0920		13.250	1000			7.8	96	36	184.0		33.5
SR-05	720607	0920	(C)	720608	0900		13.200	900		501	8.1	180	130	182.0	100	
SR-05	720608	0900	(C)	720609	0800		12.750	900	65.0		7.9	92	68	193.0		
SR-05	720609	0820	(C)	720610	0850		12.550	900	58.0	517	8.1	76	72	160.0	95	
SR-05	720610	0850	(C)	720611	0805		13.200	800	45.0		7.7	96	64	160.0		
SR-05	720611	0805	(C)	720612	0835		13.200	1000	52.0	541	7.7	96	64	137.0	76	
NUMBER							10	7	5	4	7	7	7	7	4	3
MAXIMUM							13.250	1000	74.0	541	8.3	180	130	193.0	100	33.5
MINIMUM							12.550	800	45.0	490	7.7	76	36	137.0	73	32.0
MEAN							13.085	900	58.8	512	7.9	111	76	167.4	86	32.8
SR-06	720605	1425					13.150									
SR-06	720606	0920					13.150									33.0
SR-06	720605	0930	(C)	720606	0920		13.150	900	33.0	431	8.2	78	56	147.0	72	31.0
SR-06	720607	0915					13.250									
SR-06	720606	0920	(C)	720607	0915		13.250	1000			8.0	52	40	147.0		31.5
SR-06	720607	0915	(C)	720608	0905		13.200	900		471	8.0	64	44	143.0	100	
SR-06	720608	0905	(C)	720609	0825		12.750	800	52.0		7.8	48	24	184.0		
SR-06	720609	0825	(C)	720610	0900		12.550	900	56.0	477	8.1	64	48	148.0	95	
SR-06	720610	0900	(C)	720611	0810		13.200	1000	44.0		7.7	48	28	142.0		
SR-06	720611	0810	(C)	720612	0845		13.200	1300	53.0	458	7.7	52	32	125.0	76	
NUMBER							10	7	5	4	7	7	7	7	4	3
MAXIMUM							13.250	1300	56.0	477	8.2	78	56	184.0	100	33.0
MINIMUM							12.550	800	33.0	431	7.7	48	24	125.0	72	31.0
MEAN							13.085	971	47.6	459	7.9	58	39	148.0	86	31.8

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME		DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L	00535 RESIDUE VOL NFLT MG/L	00680 T ORG C C MG/L	32240 TANNIN LIGNIN MG/L
SR-07	720605	1400					28.500								
SR-07	720605	0800	(C)	720606	0830		28.500	1300	16.0	351	8.1	36	24	118.0	67
SR-07	720606	0835					28.500								
SR-07	720606	1345					28.500								
SR-07	720606	0830	(C)	720607	0815		28.900	1200			8.3	32	16	115.0	
SR-07	720607	0630	(C)	720607	0900		28.900								
SR-07	720607	1145					28.900								
SR-07	720607	0955	(C)	720607	1145		28.900								
SR-07	720607	1245	(C)	720607	1445		28.900								
SR-07	720607	1545	(C)	720607	1745		28.900								
SR-07	720607	0815	(C)	720608	0815		29.300	1000		361	8.2	36	12	125.0	94
SR-07	720608	0630	(C)	720608	0910		29.300								
SR-07	720608	1100					29.300								
SR-07	720608	1005	(C)	720608	1145		29.300								
SR-07	720608	1240	(C)	720608	1445		29.300								
SR-07	720608	1540	(C)	720608	1740		29.300								
SR-07	720608	0815	(C)	720609	0805		28.300	900	17.0		7.9	20	8	125.0	
SR-07	720609	0935					28.500								
SR-07	720610	0805					28.500								
SR-07	720609	0805	(C)	720610	0805		28.500	1200	16.0	360	8.2	12	8	125.0	92
SR-07	720610	0805	(C)	720611	0750		30.100	1100	17.0		8.2	28	12	120.0	
SR-07	720611	0640	(C)	720611	0845		30.100								
SR-07	720611	0945	(C)	720611	1145		30.100								
SR-07	720611	1415	(C)	720611	1615		30.100								
SR-07	720611	1805					30.100								
SR-07	720611	1710	(C)	720611	1805		30.100								
SR-07	720611	0750	(C)	720612	0805		29.300	900	19.0	360	7.9	24	12	123.0	63
SR-07	720612	0806					29.300								
SR-07	720613	0805	(C)	720614	0805		27.600	1300	17.0	353	7.7	22	15		62
SR-07	720614	0805	(C)	720615	0810		27.200	1000	16.0	352	7.7	10	8	123.0	67
SR-07	720615	0810	(C)	720616	0740		28.500		20.0	328	7.7	18	10		67
NUMBER							31	9	8	7	10	10	10	8	7
MAXIMUM							30.100	1300	20.0	361	8.3	36	24	125.0	94
MINIMUM							27.200	900	16.0	328	7.7	10	8	115.0	62
MEAN							29.016	1100	17.3	352	8.0	24	13	121.8	73

C7

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00010 WATER TEMP CENT	31505 TOT COLI MPN CONF /100ML	31615 FEC COLI MPNECMED /100ML	32730 PHENOLS UG/L	00545 RESIDUE SETTLBLE ML/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00665 PHOS-T P-WET MG/L
SR-07	720605	1400				33.0	3900	170			0.88	4.020	0.410	
SR-07	720605	0800	(C) 720606	0830					54					
SR-07	720606	0835				26.5								
SR-07	720606	1345					49000	130						
SR-07	720607	0815				30.0				1K	0.97		0.500	0.960
SR-07	720606	0830	(C) 720607	0815										
SR-07	720607	0630	(C) 720607	0900			17000	330						
SR-07	720607	1145							30					
SR-07	720607	0955	(C) 720607	1145			2200	310						
SR-07	720607	1245	(C) 720607	1445			54000	700						
SR-07	720607	1545	(C) 720607	1745			35000	310						
SR-07	720607	0815	(C) 720608	0815						1K	1.00	4.510	0.450	0.900
SR-07	720608	0630	(C) 720608	0910			35000	230						
SR-07	720608	1100							26					
SR-07	720608	1005	(C) 720608	1145			17000	170						
SR-07	720608	1240	(C) 720608	1445			24000	90						
SR-07	720608	1540	(C) 720608	1740			33000	130						
SR-07	720608	0815	(C) 720609	0805						1K	1.15	4.350	0.550	0.830
SR-07	720609	0935							27					
SR-07	720610	0805							30					
SR-07	720609	0805	(C) 720610	0805						1K	1.05	4.100	0.550	0.820
SR-07	720611	0750							26					
SR-07	720610	0805	(C) 720611	0750						1K	1.33	4.200	0.550	0.860
SR-07	720611	0640	(C) 720611	0845			7900	790						
SR-07	720611	0945	(C) 720611	1145			11000	1300						
SR-07	720611	1415	(C) 720611	1615			1700	90						
SR-07	720611	1710	(C) 720611	1805			1300	70						
SR-07	720611	0750	(C) 720612	0805						1K	1.01	3.880	0.550	0.920
SR-07	720612	0806							20					
SR-07	720613	0805	(C) 720614	0805							0.68	3.500	0.600	1.100
SR-07	720614	0805	(C) 720615	0810									0.650	1.050
SR-07	720615	0810	(C) 720616	0740								3.500	0.750	1.050
NUMBER						3	14	14	7	6	8	8	10	9
MAXIMUM						33.0	54000	1300	54	1	1.33	4.510	0.750	1.100
MINIMUM						26.5	1300	70	20	1	0.68	3.500	0.410	0.820
MEAN						29.8	20857	344	30	1	1.01	4.007	0.556	0.943

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L	00535 RESIDUE VOL NFLT MG/L	00680 T ORG C MG/L
SR-08	720607	1045					5K	0.1	50K	6.4	5K	5K	1.0K
SR-08	720610	0845					5K	0.3	50K	5.5	5K	5K	1.0K
NUMBER							2	2	2	2	2	2	2
MAXIMUM							5	0.3	50	6.4	5	5	1.0
MINIMUM							5	0.1	50	5.5	5	5	1.0
MEAN							5	0.2	50	5.9	5	5	1.0

STATION	DATE	TIME	DATE	TIME	DEPTH	32240 TANNIN LIGNIN MG/L	00010 WATER TEMP CENT	32730 PHENOLS UG/L	00545 RESIDUE SETTLBLE ML/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00665 PHOS-T P-WET MG/L
SR-08	720607	1045				0K		38		0.01K	0.050K	0.090	0.010K
SR-08	720610	0845				0K		52		0.01K	0.050K	0.100	0.010K
NUMBER						2		2		2	2	2	2
MAXIMUM						0		52		0.01	0.050	0.100	0.010
MINIMUM						0		38		0.01	0.050	0.090	0.010
MEAN						0		45		0.01	0.050	0.095	0.010

ENVIRONMENTAL PROTECTION AGENCY REGION IV
SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA

PERDIDO FIELD STUDY (ST. REGIS) 1972

STATION	DATE	TIME		DATE	TIME	DEPTH	50050 CONDUIT FLOW MGD	00080 COLOR PT-CO UNITS	00310 BOD 5 DAY MG/L	00340 COD HI LEVEL MG/L	00403 LAB PH SU	00530 RESIDUE TOT NFLT MG/L	00535 RESIDUE VOL NFLT MG/L	00680 T ORG C C MG/L	32240 TANNIN LIGNIN MG/L	00010 WATER TEMP CENT
SR-09	720605	1440					25.900									33.0
SR-09	720606	0815					25.900									32.0
SR-09	720605	1000	(C)	720606	0815		25.900	1300	17.0	389	8.3	68	44	131.0	68	
SR-09	720607	0800					26.500									30.5
SR-09	720606	0815	(C)	720607	0800		26.500	1300			8.3	56	36	149.0		
SR-09	720607	0800	(C)	720608	0805		26.800	900		424	8.2	84	44	150.0	96	
SR-09	720608	0805	(C)	720609	0745		25.900	1100	29.0		8.1	56	36	131.0		
SR-09	720609	0745	(C)	720610	0750		26.200	1300	27.0	430	8.0	72	44	170.0	93	
SR-09	720610	0750	(C)	720611	0740		27.100	1200	23.0		8.2	64	36	125.0		
SR-09	720611	0740	(C)	720612	0750		26.500	1000	26.0	418	7.9	64	36	150.0	67	
SR-09	720613	0755	(C)	720614	0755		25.300	1300	20.0	378	7.8	42	28	88.0	66	
SR-09	720614	0755	(C)	720615	0800		25.600	700	18.0	364	7.8	36	24	123.0	66	
SR-09	720615	0800	(C)	720616	0725		26.800		18.0	356	7.8	40	22	125.0	67	
NUMBER							13	9	8	7	10	10	10	10	7	3
MAXIMUM							27.100	1300	29.0	430	8.3	84	44	170.0	96	33.0
MINIMUM							25.300	700	17.0	356	7.8	36	22	88.0	66	30.5
MEAN							26.223	1122	22.3	394	8.0	58	35	134.2	75	31.8

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